
Space Weather Technical Forecast

Issued on Friday, 06 May 2022 at 13:06 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Further R1/R2 radio blackouts Likely, Slight Chance of R3.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Moderate over the past 24 hours, with GOES16 recording frequent C-class activity, but with a decreased intensity compared to the preceding 24-hour period. Activity peaked with an M2.2 flare at 05/1316 UTC from AR3004 and an M2.7 at 05/1410 from AR3006. These regions had shown a possibly coincidental tendency in the recent past to flare at similar times and with similar cadence, despite their large separation on the disc, although this effect became less noticeable with time. Growth trends in both were slow, with AR3004 showing some fading of its central delta spot and trailing group, with the leader becoming more symmetric to finish as a Dhc/Beta-Gamma-Delta. AR3006 in the southeast quadrant showed a fading leader with its penumbra, leaving the delta spot as the centre of gravity, becoming surrounded by small umbrae as time went on from the large containing plage, ending the period as a Cai/Beta-Delta. There are up to three other numbered sunspots on the visible disc, AR2999 and AR3001, both stable and unipolar Hsx/Alpha, as well as a small and fading Bxo/Beta in the form of AR3003.

The Earth-facing side of the disc currently retains strongly demarcated striping in HMIBC imagery in the solar 'tropics', with the result that there are numerous filaments occupying these latitudes. One of the largest of these (located in the central northern solar hemisphere) showed possible partial disappearance in El Teide H-Alpha around 06/1100UTC. It is not clear whether this left the immediate solar environment at the time of writing, with nothing in coronagraphs. At present then, there are no Earth-directed Coronal Mass Ejections (CMEs) in available satellite imagery.

Solar Wind / Geomagnetic Activity: The solar wind followed a slow regime, with the solar wind speed at ACE generally between 300-400 km/s, perhaps with a slight rising trend overall. The solar wind density was similarly unremarkable in low single-figures ppcc, while the IMF was stable at or below 7nT, with a north-south component of +4/-6nT. The phi angle was predominantly negative (towards the Sun). The resulting geomagnetic activity was Quiet throughout (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours.

The high energy electron flux has varied between Moderate and High levels, reaching a peak of 1687 pfu at 05/1715 UTC. Electron fluence followed a slightly increasing trend, with the 06/0001UTC observed 24-hour integrated value being 5.91e7pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are likely from AR3004 or AR3006, with a daily Slight

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

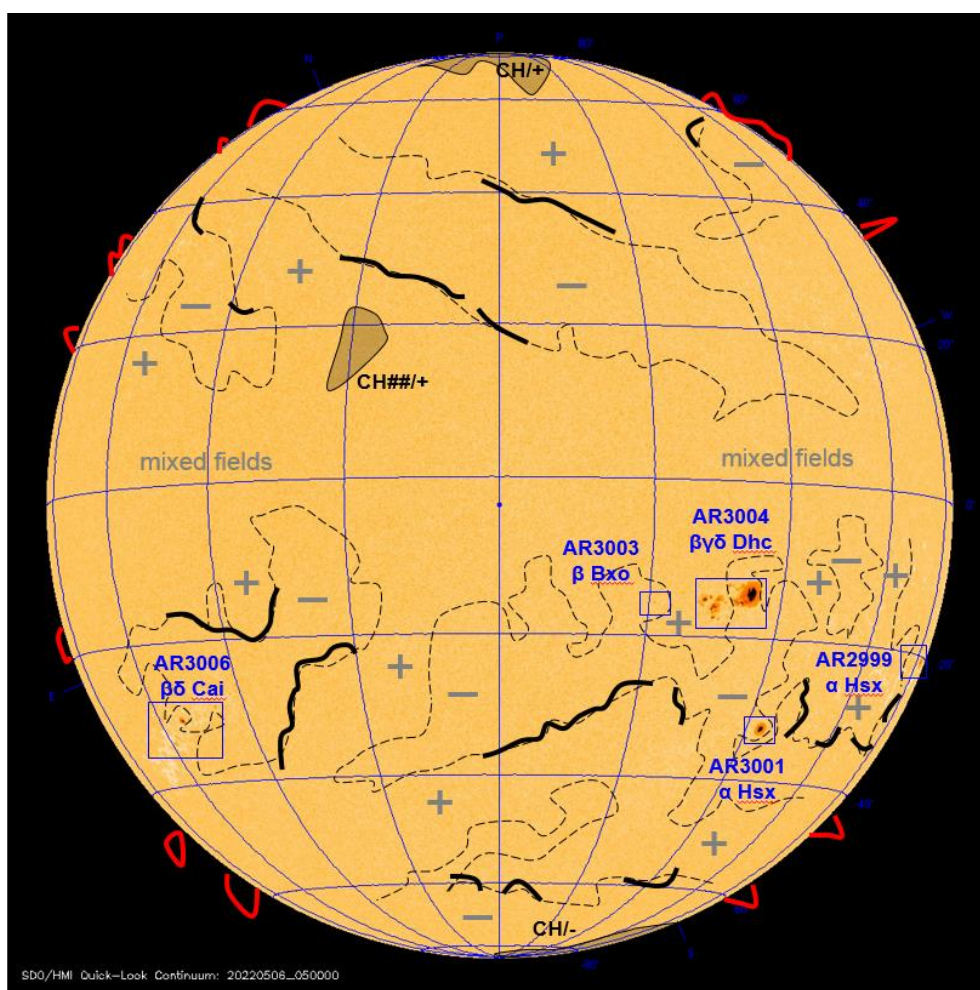
Chance of X-class. A new and potentially active region appears likely to rotate onto the southeast limb within the next day or two, while no large groups leave the disc, meaning a possible rising trend in risk, pending any arrivals for analysis.

Solar Wind / Geomagnetic Activity: No coronal holes feature in this forecast. Reanalysis of a centre-disc disturbance from the vicinity of AR3004 at 1700UTC on 03 May has resulted in a low confidence CME with an Earth-bound component, with arrival most likely late on 07 May or possibly into early 08 May. There is a peak Chance of Minor Storm G1 from this event, else geomagnetism should remain Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, and is expected to continue at this level through the period. There is a daily Slight Chance of S1 or above, largely as a result of 3004's westward advance.

The high energy electron flux (greater than 2MeV) is forecast to continue between Moderate and High in its diurnal oscillation, but with a gradual slight decline in fluence through the period in the unsupportive current solar wind environment. The daily Chance of Active fluence should therefore fall with time, perhaps sharply later in the period should the CME materialise.

Figure 1. Solar Analysis Valid 06/0500UTC.



Key: Filament —, Prominence —, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - γ - β γ δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

No coronal holes feature in this forecast period, and the only potential disruption to an otherwise slow solar wind regime and Quiet outlook is a low confidence CME arrival.

The CME stems from a re-analysis of a centre-disc dimming (e.g. in AIA171) in the vicinity of AR3004 on 03 May at 1700UTC. Resulting coronagraph imagery was patchy, but the bulk of the ejecta appears to be angled above and behind the Earth in the track of its orbit. Despite this, there appears to be a likely Earth-bound component, not least because of its central emission location.

The latest MOSWOC Enlil run puts arrival of this CME late on Saturday 07 May, with effects probably ongoing into Sunday 08 May before declining to Quiet once again. Confidence is low, but because of the diffuse nature of the ejecta, the slow speed of transit and the lack of an obvious accompanying flare on emission, an event on the lower end of the G-scale is suggested, if indeed the CME manifests at Earth at all.

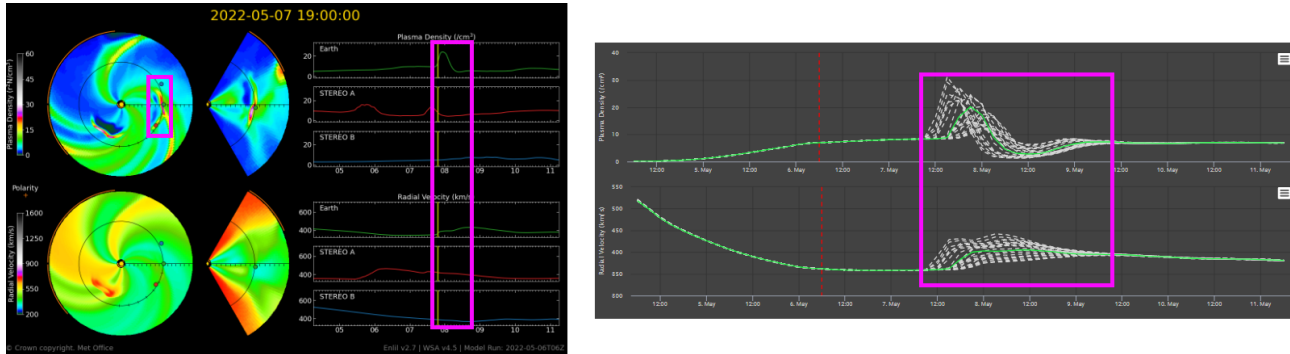
MOSWOC Enlil current offers a rogue speed increase into 08 May that is not expected to occur (for lack of coronal hole fast winds), however this should have minimal effect on the CME, which is expected to reach 1AU before this.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	30	40	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/0552	Partial	Vicinity of AR3004	NE quadrant	407km/s	Late 07 May into 08 May	Low confidence

Figure 2: Latest MOSWOC Enlil run and ensemble, showing weak hit from 03/1700UTC CME. In part owing to its late arrival on 07 May, much of the risk of G1 falls within the following UTC day of Sunday 08 May. Confidence for this event is lower than the ensemble may suggest, with a greater spread in solutions preferred (mostly later in the UTC weekend) and range of peaks (mostly lower than shown).



Radio Blackouts - X-Ray Flares:

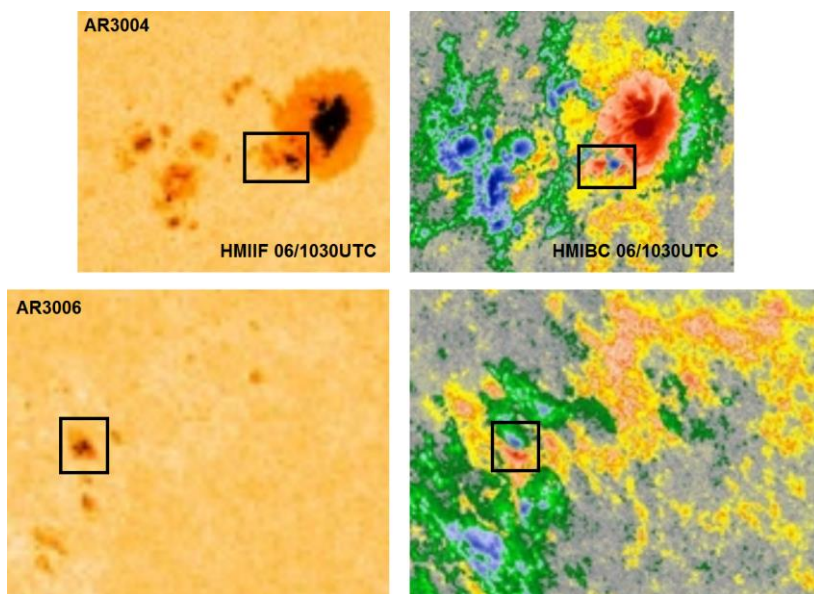
There are currently five sunspots on the visible disc, with activity dominated by the duo of AR3004 and AR3006. Both of these groups appear to retain a Mt Wilson delta spot in some form, although both are perhaps less clear-cut than 24 hours ago, perhaps going some way to explaining the observed decline in background X-ray flux at GOES16. The risk of flares is roughly equally partitioned between these two groups, as although areally larger and of a nominally 'more threatening' Zurich class, the growth trend in AR3004 is stalling as AR3006's is strengthening.

Regarding the overall balance of sunspot groups on the Earth-facing disc, an overnight UTC CME from behind the eastern horizon perhaps points at a notable region in this vicinity (100E), with a crossing onto the front side expected this coming UTC weekend, although any upturn in X-ray risk will be assessed once this occurs.

Departures in the four days are likely to be less significant: AR2999 will shortly cross the western limb to little fanfare. Meanwhile, to complete the round-up of the disc, its surviving eastern neighbours of AR3001 and AR3003 are expected to contribute little to the risk of flares in the period.

X Flares	Ray Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: HMIIF and HMIBC of the two largest and most active sunspot regions on the disc, with possible Mt Wilson delta spots shown boxed in black.



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.

There is a daily Slight Chance of S1 or above, largely as a result of AR3004's advance across the western hemisphere, although it does not have a history of producing any proton response at GOES16, despite a series of moderate flares.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Probability (Exceedance)						
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

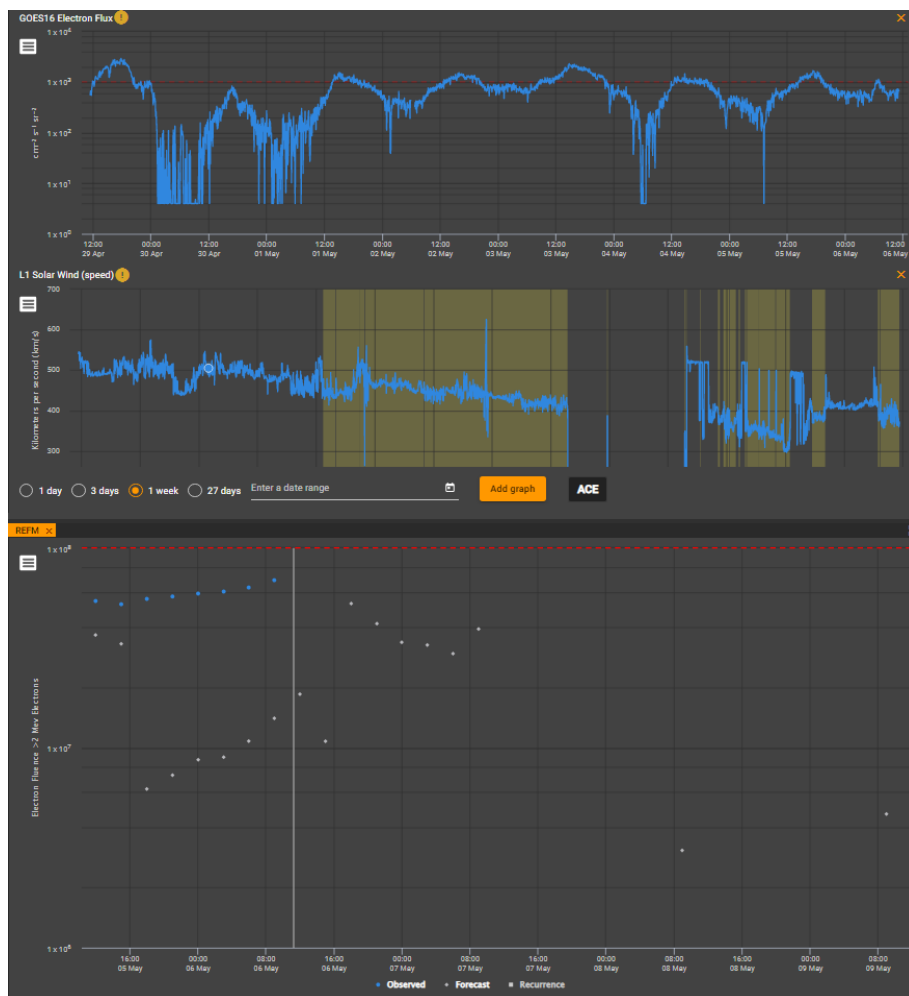
The high energy electron flux (greater than 2MeV) is forecast to continue between Moderate and High in its diurnal oscillation, but with a gradual slight decline in fluence through the period in the unsupportive current solar wind environment.

A daily Chance of Active fluence (1e8 integrated flux) should therefore fall with time, especially with potential significant geomagnetic activity occurring in the wake of any CME late on 07 May and into 08 May. The latest MOSWOC REFM is therefore considered to be offering good guidance in keeping the fluence below the Active threshold and with a declining trend.



GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	40	30	10	10
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 4: Top to bottom: Past week in GOES16 high energy electron flux; L1 solar wind speed (ACE shaded yellow) showing response to exit from CH78's high speed stream; and MOSWOC REFM, showing sub-Active forecast and observations.



NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.